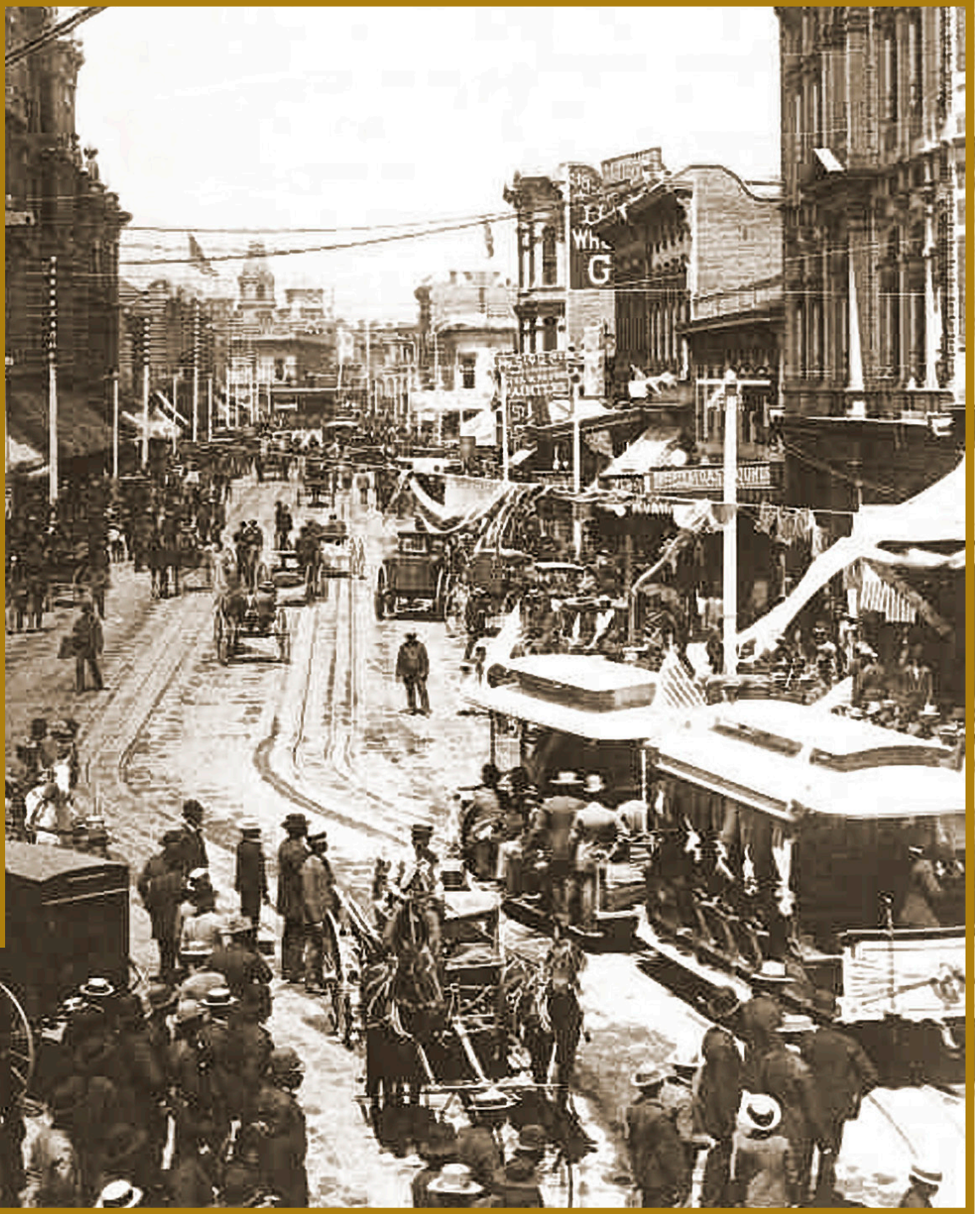


10

World History  
History-Social  
Science Standard  
10.3.3.



# Growth of Population, Cities, and Demands

## **California Education and the Environment Initiative**

Approved by the California State Board of Education, 2010

### **The Education and the Environment Curriculum is a cooperative endeavor of the following entities:**

California Environmental Protection Agency  
California Natural Resources Agency  
Office of the Secretary of Education  
California State Board of Education  
California Department of Education  
California Integrated Waste Management Board

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### **Key Partners:**

Special thanks to **Heal the Bay**, sponsor of the EEI law, for their partnership and participation in reviewing portions of the EEI curriculum.

Valuable assistance with maps, photos, videos and design was provided by the **National Geographic Society** under a contract with the State of California.

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# Los Angeles on the Move

## Industrial Revolutions Create Cities

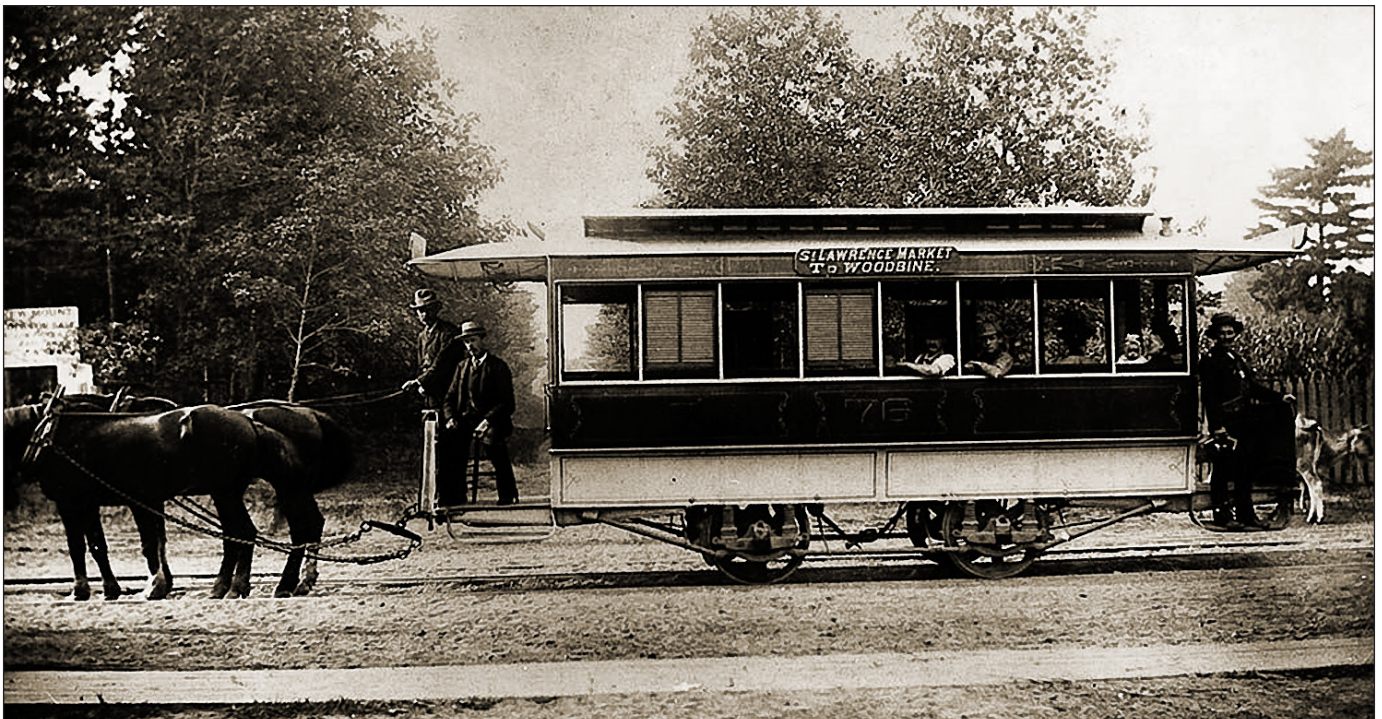


The Industrial Revolution of the 18<sup>th</sup> and 19<sup>th</sup> centuries dramatically changed how people live and work. In the late 1700s, the Industrial Revolution transformed farming and manufacturing with steam and water-powered machinery. People from rural areas migrated into the cities, where they were able to find work in factories. The second Industrial Revolution, which began in the mid-19<sup>th</sup> century, was marked by the advent of iron and steel manufacturing and electric power.

During the Industrial Revolution, cities became more dense and complex, with industrial and residential areas interwoven. As more people moved to the cities, transportation systems evolved to

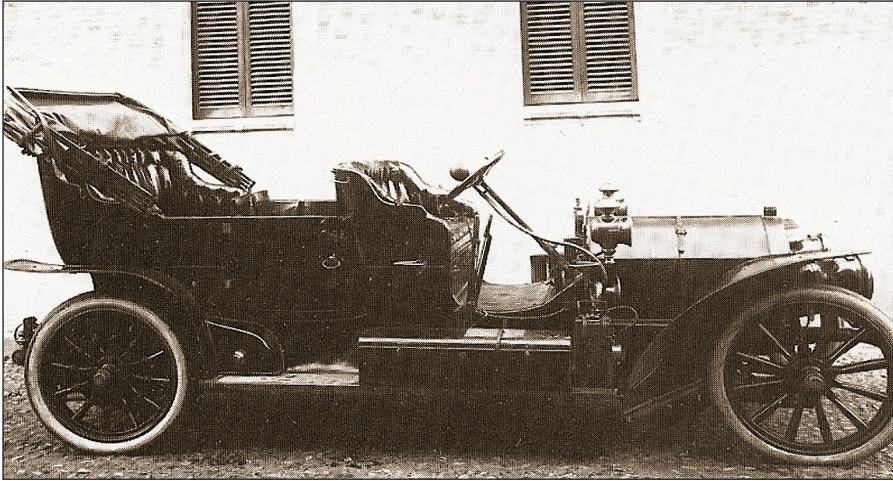
meet their needs. In turn, the transit systems and vehicles evolved as new power sources became available. Horse-drawn streetcars were replaced by electric trains, which were then

replaced by automobiles. The Los Angeles transit system's history provides a glimpse into the changing environment in what would become California's largest city.



1800's horse-drawn streetcar





Early automobile, 1902

### Los Angeles: From Village to Metropolis

Before the “City of Angels” was founded in the late 1700s by the Spanish, local Indian tribes lived off the land. People did not regularly travel great distances, and goods were moved by horse, cart, or foot. As Spanish settlers and Mexican ranchos moved in and claimed land, they brought with them the agricultural lifestyle, raising cattle herds and trading hides for supplies. This society required new methods to move people and goods, but the transportation changes did not require significant quantities of local natural resources.

As of 1850, Los Angeles, by then a part of the United States, began to transition to the ways of the nation as a whole in relation to its use of natural resources and movement toward industrialization. In the 1870s, only about 6,000 people lived in

Los Angeles. (That is the size of two large Los Angeles high schools today!) A decade later, there were twice as many people, and, by 1890, the population had increased tenfold to more than 50,000. With the increase in population came the need for new and innovative ways of moving people and goods. As new transportation systems emerged, local natural systems were altered and the demand on natural resources increased.

By the late 1800s, the first oil wells in the city had been drilled, and streetcars carried people to work and shopping areas. The Port of Los Angeles had opened the city to trade with other coastal cities and countries. Railways connected Los Angeles to San Francisco and to the east, bringing commerce and people to the city. The port and railways also supported new industries, such as fishing, canning,

shipbuilding, and movie making. Immigration continued at a rapid pace, and, by 1930, one million people called Los Angeles home.

While this rapid increase in population reflected the prosperity of the area, it created pressures on the city and its residents. People needed reliable and affordable transportation to carry out their daily lives. The second Industrial Revolution’s innovations facilitated the continued growth of Los Angeles by providing power, transportation, and natural resources.

### The Emergence of Mass Transit

As industry moved into the city, so did people. Suburbia grew around the city center, giving birth to the “commuter” lifestyle. Hollywood and its motion picture industry made Los Angeles a very popular place to live in, work in, and visit. The Los Angeles area transit system would evolve, from horse- and mule-drawn streetcars to electric railways and automobiles.

In 1873, the City granted the first franchise for a streetcar system. Horses and mules powered the early streetcars. By the 1890s, cable cars had become more widespread. The cables that pulled the streetcars were laid underground in a continuous loop. Coal-fired steam engines pulled the cables. The

cable cars traveled across a large network of street rails and viaducts (long elevated roadways that usually consist of a series of short spans supported on arches, piers, or columns). Cable car operators worked very long days, and the cars were often crowded.

As Los Angeles continued to grow, homes and businesses needed more water and power. In the early 1900s, city leaders began looking for both. The first aqueducts were built shortly thereafter to import water from lakes high in the mountains, like Mono and Owens lakes to the north. Eventually, water was imported hundreds of miles from the Colorado River. In 1936, the Hoover Dam was

completed and began supplying Los Angeles with hydroelectric power. New supplies of water and electricity created new transportation options, such as electric railways, and expanded the aviation and oil industries in the area. However, droughts and energy shortages, coupled with the introduction of the automobile and relatively cheap gas, brought about the demise of the electric railways.

The state's first oil fields were in Southern California. California Indians and early settlers used the tar seeps to seal canoes. Later, researchers would find millions of fossils from the Pleistocene period in the La Brea tar pits. The first oil well in Los

Angeles was drilled in 1892. By 1923, California was the largest oil-producing state in the nation, providing more than one-quarter of the world's oil. In fact, Signal Hill, near Long Beach, was once one of the most productive oil fields in the world. Prospective homeowners who already owned lots on Signal Hill decided to build wells instead of homes. Surprisingly, most of these people actually made money on their investments.

The oil boom caused more people to settle and work in Los Angeles and it also brought wealthy investors, who joined the rail tycoons to develop the city's infrastructure and industry. Competition between



Signal Hill, California 1923





Los Angeles public transportation, 1953

the railways became fierce. This competition spurred the transition from the steam locomotive to the faster interurban electric railway. By the 1920s, the Los Angeles rail system spanned 1,100 miles, making it the world's largest railway. The city's subway opened in 1928, but between the 1920s and 1940s, cars and buses became very popular. By the late 1940s, gas was cheap, owning an automobile was the "American Dream," and the first freeways were opened. As auto and bus use increased, rail transit diminished. In 1963, rail service ended in Los Angeles. For almost 30 years, the city would be without rail service.

### The Car Culture

Most American cities, like Los Angeles, embraced the car culture in the 1950s and 1960s. As the city continued to grow in the 70s and 80s, congestion worsened. Today, Los Angeles is considered to have the worst traffic congestion in the nation. Movies, books, and television programs depict people getting frustrated sitting in Los Angeles "traffic jams." However, this wasted time is not the only consequence of the car culture. The exhaust from the cars and buses creates a semi-permanent layer of smog over the city, resulting in the deterioration of air quality in the Los Angeles

Basin. In fact, Los Angeles has some of the dirtiest air in the world, leading to a myriad of public health issues.

By the 1990s, overwhelming public support brought mass transit by rail back into Los Angeles. Today's Los Angeles Metro System is comprised of a subway (heavy rail) and train (light rail) system. Approximately 300,000 people ride the Metro each day.

Today, 4 million people live in Los Angeles, making it California's most populous city and the second largest city in the nation. But with less than 1% of the city's population using mass transit, the Los Angeles traffic problem is not expected to get better. Perhaps the congestion will create nostalgia for train travel and resurgence in mass transit. And maybe we will see a third Industrial Revolution marked by innovations in transit sometime this century. California is already working to create more sustainable fuel sources, vehicles, and transit systems. Ironically, urban sprawl is now reversing the Industrial Revolution's immigration trend: People are migrating out of the cities to more rural areas. Coupled with the increasing costs of fuel, mass transit is now not only attractive but also imperative.

# Manchester, England

Manchester is a city in the southeast part of the county of Lancashire, England. Manchester started as a small town but grew quickly into a busy, cotton-processing city. In fact, the city later became the world's largest marketplace for cotton goods. During the late 19<sup>th</sup> century, Manchester was called "Cottonopolis" and "Warehouse City."

Manchester's rise in textile manufacturing was mostly due to its location. Its damp climate was better for producing cotton than was the drier climate of eastern England, which was where many of the older manufacturing centers were located. Manchester was close to the Atlantic seaport of Liverpool and was later connected to Liverpool by one of the earliest railways and a wide canal. Although 30 miles inland, Manchester became a major port once the railway and canal were built. Manchester was also close to natural power sources. It received water power from rivers in the Pennine Mountains, and later, coal from the mines in central Lancashire. As a result, Manchester became, perhaps, the first modern industrial city.

The transformation from a small market town to a major city began in 1761, when a small canal was put to use, allowing cheap coal to be transported to Manchester. By the end of the 18<sup>th</sup> century, Manchester had become the center for the cotton industry in Lancashire. Merchants brought raw cotton from Liverpool and then sold it to businessmen in Manchester. The businessmen then gave it to the spinners, who worked in cottages. In the 1770s, the invention of machines, such as the spinning jenny and the water frame, completely changed the way that cotton goods were made. The machines in the first cloth factories were driven by water power and were built in villages near fast-flowing streams. By 1790, there were about 150 water-powered cotton-spinning factories in Britain. Factory owner Richard Arkwright was quick to see the

importance of the rotary steam engine, invented by James Watt, and in 1783 he began using the engine. With the invention of Watt's steam engine, factories no longer had to be built close to fast-flowing rivers and streams. Entrepreneurs now tried to build factories where there was a good supply of labor and coal. Manchester had both, allowing cloth manufacturing to be performed in factories instead of cottages.

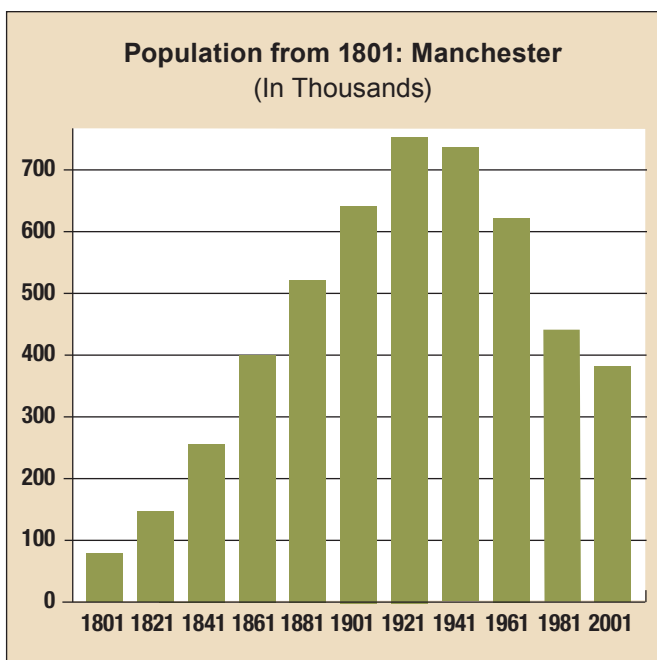
Manchester became one of the best places to build textile factories because of its close proximity to cheap coal and its ability to transport resources and goods. Large warehouses were built to store and display the spun yarn and finished cloth.





Once general manufacturing came to Manchester, entrepreneurs developed machines for other uses. The chemical industry and financial services, such as banking and insurance, also made their homes in Manchester. The town's population grew rapidly. With neighboring Salford, Manchester had about 25,000 inhabitants in 1772. By 1800, the population had grown to about 85,000. Rich manufacturers built large houses for themselves, while factory workers lived in small houses built close together and close to the factories where people worked. The Stockton & Darlington railroad opened in 1825 and lowered the cost of transporting coal. Large profits were made by building railways, and, by September 1830, the Liverpool & Manchester railway opened with great success.

The railway quickly increased the population of Manchester. By 1851, about 340,000 people were living in the city. Housing conditions were horrible. It was reported that in some parts of the city there were only two toilets for every 250 people. Partly due to such harsh living conditions, only 40% of the children living in this area reached their fifth birthday.



Manchester, England

Ida Wells, the famous American anti-lynching crusader, visited Manchester in 1894. In her autobiography, written years later, this is how she described the city:

*Liverpool has few manufacturing interests. Her importance is derived from her situation as a seaport; her life is purely commercial, and her wealth is derived from handling the produce of other towns and countries.*

*Manchester on the other hand is an enormous manufacturing centre. There are nearly five hundred cotton spinning firms in and about the city, and these own over eighteen million spindles, more than one-third of all those in Great Britain. There are chemical works and great engineering factories, and the export and import trade of these industries is of great magnitude. Liverpool and the railroads made these burdens too grievous to be borne, besides diverting this trade from Manchester, and the ship canal is the result.*

*The largest ships bringing produce, cotton and iron to the markets and mills, need not now wait in vexatious [annoying] delay outside Liverpool to be docked but steaming up the canal, reach Manchester as quickly as they can be unloaded from vessels and on the railroads in Liverpool. In return manufacturers can ship machinery and cotton goods to all parts of the world, direct from Manchester factories at far less cost and delay. Where there was formerly a small stream of water winding in and out toward the sea, there is now a broad, deep canal, twice the width of the Suez Canal, and any two of the largest vessels can sail together abreast along its water.*

Source: Wells, Ida B. *Crusade for Justice: The Autobiography of Ida B. Wells*. Chicago: University of Chicago Press, 1991.

# Essen, Germany

Essen, Germany, was founded as a monastery for women in the ninth century. It remained a farming town until the 19<sup>th</sup> century, when it became the largest city in the Ruhr Region of Germany. Although the Industrial Revolution came late to Germany, during this time period the city developed into the most important mining town in Europe. It produced coal, iron, and steel. The city of Essen was called the “armor of the nation” due to its steelworks industry and weapons manufacturing.

Essen is part of an area of farming land in the Ruhr Region, which once successfully produced food and farmed crops. When many coalfields were discovered, coal became the area's source of wealth during the Industrial Revolution. Coal was removed from hundreds of small mines throughout the hillsides. Larger coal deposits were found deeper in the earth below layers of rock. Some deep mines dropped down 1,000 feet into the earth. Steam engines helped pump water from the mines and haul coal and waste, which made it possible to mine even deeper. Soon, the number of large mines increased, and hundreds of smaller mines stopped production.

Industrialization in Germany started later than in France and the United States. Building a good labor force was difficult in Germany until the 1840s. Finding skilled workers in the region was not easy in the rural agricultural regions. Despite this, coal mining began to expand rapidly by the 1830s, almost doubling in that decade alone. Between the 1840s and 1870, German coal production increased greatly as deeper mines were sunk, particularly near Essen. In the 1850s, iron production increased at a rate of 14% per year. By then, Germany was actively building a railroad network. As a result, forests were cleared for much of the mining and railroads.

In the 1870s, Germany benefited when the French provinces of Alsace and Lorraine became a part of Germany. Those provinces

had developed industries, including textiles and metallurgy, which is the production of metal. Development of new smelting processes led to larger use of phosphorus-rich Lorraine ore. The use of Lorraine ore produced a higher quality iron and increased Germany's industry. By 1913, Lorraine was producing 47% of all iron ore mined in Europe. Most of this profit went to Germany. At this time, separating metals from ore became easier with the use of high-heat coal. Coal was removed from the earth and replaced charcoal as a fuel source. This helped the industry because charcoal,





which comes from wood, was more difficult to obtain after many years of cutting down forests.

In 1811, Friedrich Krupp founded the Cast Steel Factory in Essen. His son Alfred, invested in new technologies for heavy industry and began investing in railway materials and locomotives. Alfred achieved national fame when he introduced sick pay, free medical treatment, pensions, and retirement homes for his workers. The Krupp factory contributed to the population growth in Essen in the mid-19<sup>th</sup> century. In 1864, about 22% of Essen's citizens worked for Krupp. The Krupp works and other manufacturers filled Germany's Ruhr Valley with factories. This, in turn, made Essen the center of German industry. The region succeeded on the mining of coal and ore, which led to the large population growth and urbanization of Essen.

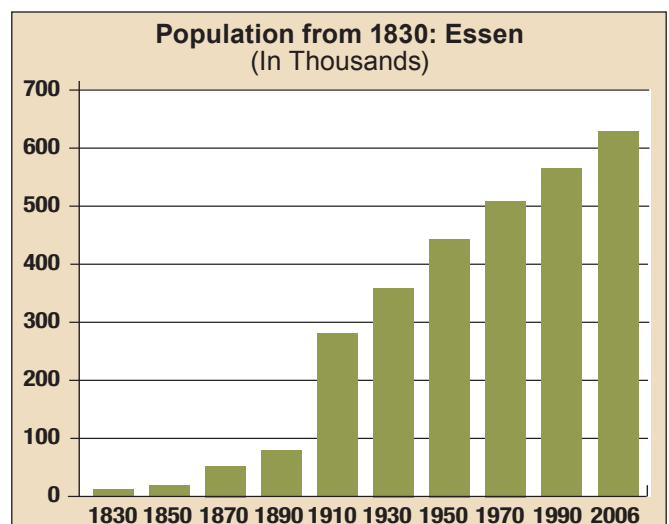
From the 1850s onward, German industrialization happened very quickly. Unlike other nations, Germany concentrated on heavy industry, using its resources of coal and iron, and focused almost all of its industry on building railroads. The German government actively supported industrialization. For example, the government introduced railroad policies, helped invest in factories, and backed investment banks.

Thousands of rural peasants migrated to the cities between 1870 and 1890 to escape a decline in farming and an over-populated countryside. Urban growth in the last quarter of the century marked a change in Germany. The country changed from being a largely rural society to a mostly urban society. In 1871, 35% of Germans lived in cities. By 1900, it was 47%, and in 1910 it was 60%. In 1871, there were eight German towns with more than 100,000 inhabitants. By 1910, the figure stood at 48. The population of Berlin, Germany's capital city, doubled, while Essen and Kiel grew by multiples of six during the same period. In 1950, Essen was the seventh largest city in the world.



Essen, Germany

As urban areas grew, the conditions within them remained good for workers and residents. The living conditions for many German workers improved when they moved to the city. Between 1880 and 1914 unemployment rates rarely went above 3%. Salaries increased between 1871 and 1912. The government and businesses provided improvements in health care and immunizations. They also developed wider roads and sanitation systems. The city provided street lighting and park facilities. Germany became one of the leading nations in community services. However, improving the living conditions affected the natural systems that provided clean air, water, forests, and land. For example, the Rhine River became one of the most polluted rivers in the world as a result of human and industrial waste.



# Osaka, Japan

Japan's industrial revolution started in the 1870s. Like other industrialized countries, building a railroad caused rapid industrial growth. Japan's Meiji government started a railroad development plan in 1870. Railroads were considered necessary to improve and modernize Japan. The government tried to raise money through investors to build a rail line between the cities of Osaka, which was close to a shipping port, and the capital city of Kyoto.

Few investors were interested, so the government built the railroad itself. As a result, Japan became one of the first countries to industrialize through the government. These rail lines immediately made a profit, and soon Japan attracted many private investors. As a result, more rail lines were built between 1881 and 1891.

The government also developed large mining industries for iron, lead, copper, gold, silver, and coal. Private mines existed, but the government mines were larger and used modern, imported machinery. The government invested heavily in the modern technologies to catch up with the rest of the industrialized world. Until 1907, Japan had to depend on European imports for heavy industries, such as shipbuilding, mining, and manufacturing. In 1907, the Kawasaki shipyard began to produce the first domestic locomotives and coaches in Japan's short industrial history.

Japan's location made it ideal for maritime business, even though Japan had restricted sea trade for more than two decades. The focus on shipping helped the Japanese escape Western control of commerce. Originally supported by the government, the Mitsubishi Company successfully began by employing samurai and buying foreign weapons and ships. Led by a samurai, or former member of Japan's military nobility of the pre-industrial era, Iwasaki Yataro (1834–1885), Mitsubishi became an independent company. Iwasaki developed a loyal, hard-working staff of former samurai. Mitsubishi competed directly

with the government shipping line, the Nippon Postal Steamship Company. The Nippon Postal Steamship Company carried passengers, rice, and other freight along the coast. Mitsubishi's ships were more modern and soon drove the Nippon Company out of business. From 1874 to 1875, the government bought 11 iron steamships and gave them to Mitsubishi to start a regular route between Japan and China. The government did this in order to compete with American and British companies. By 1877, Mitsubishi had taken most business away from these companies.

Mitsubishi made a fortune and began to expand into insurance and foreign-exchange (banking). Rival companies and more big business began to





emerge in Japan. Industrial growth began in the 1880s with big businesses known as “zaibatsu.” These industrial giants included a farmer named Shibuzawa Eiichi, who was born into a peasant family and later owned the Osaka Cotton Spinning Mill. Shibuzawa had learned that huge profits could be made with huge mills. These mills increased yarn and cloth production. As a result, Osaka became known for its large textile industry.

During the 1890s, modern industries grew and included construction goods, such as cement, bricks, and glass. Japan also built factories for food and beer processing, and match and chemical production. Economically, Japan continued to depend on large agricultural production and a variety of small businesses. In the early 1900s, there was only a small percentage of factory workers in the total labor force. Japan’s agricultural population fell from 80% in 1870 to 67% in 1900 as people slowly started moving to the cities to work in factories. By 1920, the percentage of Japan’s rural population fell to 51% of the total population.

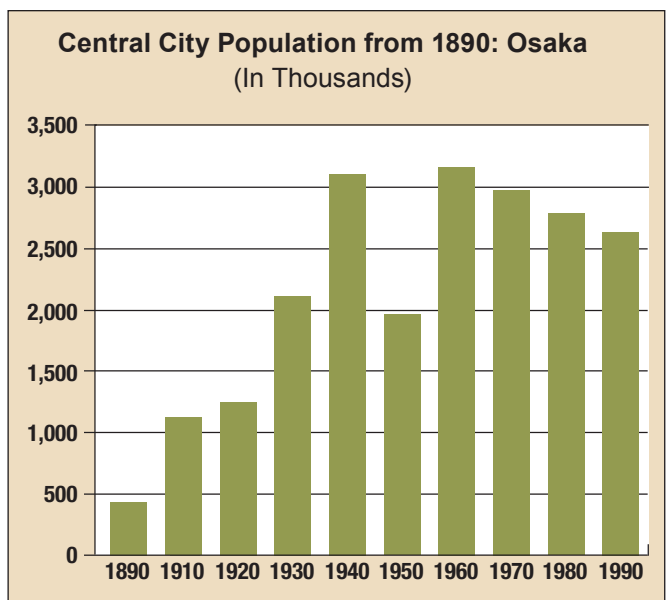
Despite rapid industrial growth, Japan depended heavily on machines and raw materials that were imported from the West. Natural resources were needed to fuel growth of industries and were not as available in Japan as they were in Europe and North America. At one time, Japan exported coal, but now needed to import coal for use in factories and transportation. The country also imported cotton, wool, timber, iron, pulp, and soda ash (used to make glass and in textiles). Japan depended heavily on international trade and, therefore, needed to create products to export, which they did quickly with silk and copper.

As factories spread, conditions became worse for the workers. Many skilled factory workers changed jobs frequently, seeking better deals from employers. This movement made employers nervous but it did not improve living conditions.



Osaka, Japan, 1933

Some workers had to borrow or sell their furnishings to live. Industrialization also affected the environment. By the end of the 19<sup>th</sup> century, so much smoke spewed from factory smokestacks that Osaka was called the “smoky city.” Factory production and crowded housing also added pollution to the water systems in and around Osaka. Over time, consumption depleted natural resources, such as coal and timber, permanently changing ecosystems. The landscape in Japan now includes large buildings, roads, and railroad tracks where forests and fields once stood.



# Chicago, United States

In 1847, the city of Chicago did not have a single mile of railroad. Ten years later, it was the rail center of America, and more railroads met at Chicago than at any other spot on Earth. In the 1860s, Chicago had replaced St. Louis as the region's major center of trade.

Chicago first became important as a trade center and later as a manufacturing center. Initially, Chicago created a system of trade for lumber and wheat. Chicago was a good location for both industries. The timber-rich lands of upper Wisconsin and Michigan were close-by, and the wheat fields of the prairies were to the south and west of the city. Chicago was built on Lake Michigan, which served as a natural “highway” between these states. In addition to using the lake for transportation, the city made use of its own river. Chicago investors purchased entire forests in the north and sent boatloads of timber down the lake to Chicago. The timber was processed and then sent out by canal and rail to markets. Lumber from Chicago's mills made cottages, schoolhouses, stores, taverns, and churches. Imagine groups of homesteaders gathering at a train stop on the prairie, waiting for a shipment of pre-made buildings from Chicago that they would use to build their town!

The wheat trade involved Chicago factories, transportation systems, and farmers. In Chicago, factories made iron farming tools, called “reapers.” These strong tools allowed farmers to cut the wheat on their farms before transporting it to the city. From Chicago, the wheat was shipped to the rest of the world. The farmers and Chicago merchants made money in this economy. The key to their success was the railroad. Rail lines had been improved and expanded to connect farms and cities throughout the Midwest.

As food production improved and the population grew, the United States looked for new techniques and technologies to increase the quantity of crops grown. Machinery soon increased productivity so

that fewer people were needed to produce more food per acre. New plows, seed drills, cultivators, mowers, and threshers, as well as the reaper, all appeared by 1860. After that, better harvesters and binding machines came into use, as did harvester-threshers, known as “combines.” Farmers used some steam power in the late 19<sup>th</sup> century, and, ca. 1905, they began using gasoline-powered tractors. At about the same time, Americans began to apply science to agriculture, such as using genetics for plant breeding. These techniques, plus fertilizers and pesticides, helped to increase crop productivity to meet the needs in the cities. But new farming techniques led to fewer jobs for farmers. As the farm jobs decreased, farmers moved to the city in search of work. Another problem with these new techniques was the use of pesticides. This problem would not be addressed until the 1960s, with the





emergence of the general public's understanding of how harmful pesticides are to the health of biological systems.

Livestock was another big industry in Chicago. Cattle, pigs, and other livestock were shipped by railroad from farms to Chicago's slaughterhouses. Processing plants packed meat and shipped it to other cities. As the refrigerated rail car improved in the mid-19<sup>th</sup> century, Chicago's meatpacking industry grew significantly. People complained about the terrible smells that surrounded the meatpacking yards and questioned the cleanliness of the plants. American author, Upton Sinclair, wrote about the corruption and horrible working conditions in Chicago's meatpacking industry in his 1906 book, *The Jungle*.

In the 19<sup>th</sup> century, American factories started using a new mechanized method of production to speed up production and produce uniform, high-quality products. The meatpacking industry in Chicago used a form of this method, as did many industries using distilling and refining processes. Those industries made products, such as kerosene, gasoline, and other petroleum products, as well as many processed foods. The meatpacking factories used the method to produce canned meat that looked and tasted the same from can to can. This style of meat soon became a popular food staple in many homes.

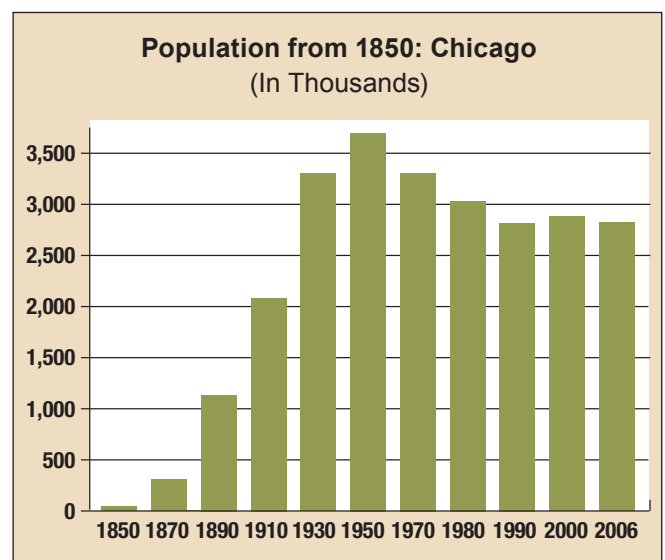
Chicago quickly grew to be an urban center and without many governmental restraints. Within 40 years, the population grew from 30,000 in 1850, to over 1 million by 1890. It became the world's fastest-growing city and was the fifth largest city in the world at the end of the 19<sup>th</sup> century. Chicago's growing economy attracted many residents from rural communities, as well as immigrants from abroad. Even after a great fire ravaged Chicago in 1871 and burned down 18,000 buildings, the city was rebuilt and became a place people visited to see great economic diversity. However, Chicago was called one of the ugliest cities in America



Chicago, Illinois

and was one of the unhealthiest, too. With quick urbanization came a great deal of sewage and industrial waste. Homes and businesses deposited waste into the Chicago River, which flowed into Lake Michigan, and polluted both sources of water. The city was forced to address the problem and build a modern water supply and sewage system when cholera spread through the city's tainted water system.

To solve the problems of sewage backup and lack of fresh water, the city of Chicago was raised out of swampy soil and the flow of the river was reversed so that the city's sewage was carried inland rather than out to the lake. Although this solution angered residents living inland from Chicago, these projects gave Chicago an outstanding reputation, which attracted even more industry and residents. The city continued to grow.



# The Alkali Act of 1863 and Robert Angus Smith

England recognized the problem of air pollution as far back as 1306, when King Edward I forbid the use of coal in London “because of the all the smoke it caused.” During the Industrial Revolution, factories began to put new and dangerous gases and particles into the atmosphere. Processing alkali—sodium carbonate—used in manufacturing glass, textile, soap, and paper—discharges hydrochloric acid (in gaseous form) into the air. These were lucrative industries for England in the 19<sup>th</sup> century, and, due to the deforestation that had occurred in the 1700s, almost all alkali had to be imported from North America and other European countries into England.



Smokestacks

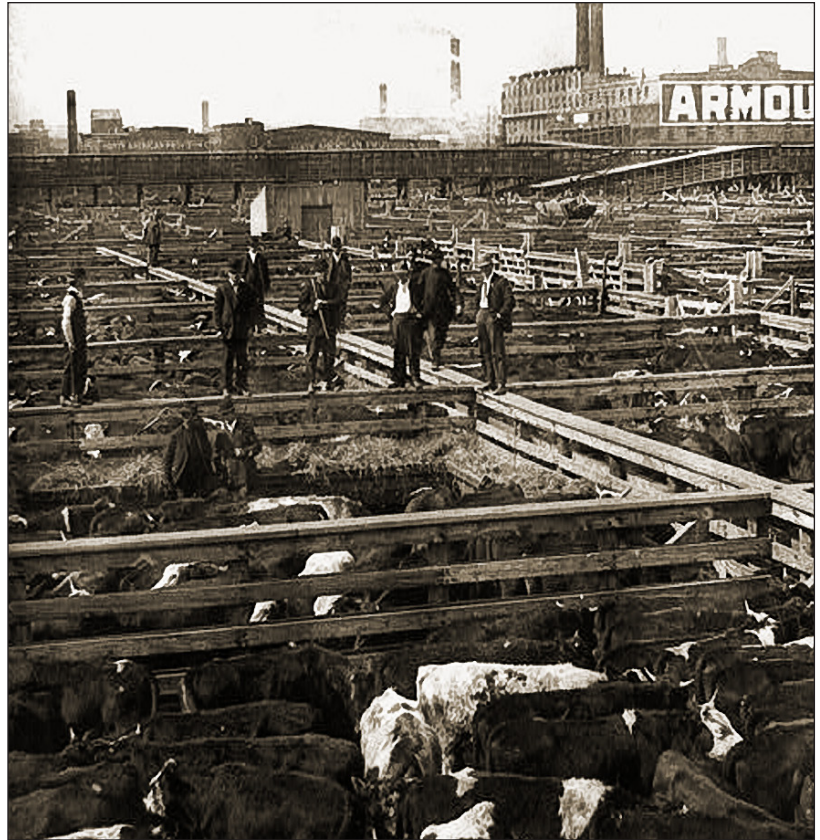
Hydrochloric acid is highly corrosive. It burns human tissue and other organic substances, as well as many minerals and metals. Once the danger of hydrochloric acid was discovered, the British passed the Alkali Act in 1863 and hired alkali inspectors to curb the discharge from England’s factories. One of Britain’s Alkali Inspectors was Robert Angus Smith (1817–1884), who was a Scottish chemist and who investigated numerous environmental issues. He is famous for his research on air pollution, which he performed in 1852. In the course of that research, Smith discovered and coined the term “acid rain.” He became involved in some environmental issues in Manchester, England, but, shortly thereafter, he opted to work as an independent chemist until he accepted the position of Alkali Inspector. In 1874, Smith became the Chief Inspector and was responsible for the standards set and maintained by the Inspectorate. For the first 60 years of its existence, the Inspectorate was solely concerned with the heavy chemicals industry but, from the 1920s onward, its responsibilities were expanded, placing all major heavy industries which emitted smoke, grit, dust, and fumes under its supervision.

Alfred, Randy. “July 18, 1876: Royal Commissioners Wrinkle Their Noses.” *Wired*. Retrieved from [http://www.wired.com/science/discoveries/news/2008/07/dayintech\\_0718](http://www.wired.com/science/discoveries/news/2008/07/dayintech_0718)



# Pollution in Chicago

Public conditions in industrialized cities were often noxious and threatening. Odors were widely believed to be a source of disease, and, in Chicago, the slaughterhouses were “diffusing the odors of animal putrefaction throughout the city,” especially in summer. In the North Branch of the Chicago River, “the water [that remained] standing with the yearly accretions [was], during the hot months converted into a cesspool, seething, boiling and reeking with filth, which [filled] the north wards of the city with noxious gases.” Soon, the South Branch had become “fully as foul.”



The meatpacking industry in Chicago relied on stockyards (1909).

Each year from 1871 to 1881, the city removed the carcasses of 1,500 horses and tens of thousands of dogs from the streets, while 70 teams tried to cope with “the garbage, ashes, and rubbish daily accumulating.” But tugboats and railroads belched smoke, the stockyards still stank, and outhouse vaults infected water wells in many back yards. The Board of Health complained that, “the great and rapid influx of population has caused a dangerous overcrowding in all the poorer districts. ...Thousands of small houses and cottages arranged for one family are now packed with a family in each room,” especially in neighborhoods of newly arrived Europeans. Chicago’s doubling of population in the 1880s, much of it from Europe, had its downside. Overcrowding produced deaths from tuberculosis, as well as from sanitary-related contagions.

Source information from the Chicago Historical Society.





Rhine River near Bingen, Germany, 1835

# Exploring the Rhine River

The Rhine is one of the most famous and important waterways in Europe. Since the days of the Roman Empire, the Rhine has been a vital waterway, used to carry people and goods deep inland from the North Sea. In 1815, the Congress of Vienna established the Rhine as a “navigable waterway,” meaning it was deep and wide enough for the passage of ships.

Water from the Rhine is used in homes, agriculture and industry, and for generating energy. The Rhine is also used as a sewer. The river served as a significant obstacle to Allied forces during World War II and is the basis for natural international borders.

The Rhine stretches over 820 miles, beginning in the Swiss Alps and flowing through Switzerland, Austria, Germany, France, Luxembourg, Belgium, and the Netherlands and into the North Sea. It

is one of Europe’s longest rivers and connects two industrial regions: the Ruhr in North Rhine-Westphalia, Germany, and Rijnmond in the Rotterdam region in the southeast part of the Netherlands. Before 1765, the river flowed unobstructed and had plenty of fish, including salmon. In fact, many people living along the Rhine River complained about having to eat so much salmon!



### Industrialization

As long as people have lived near the Rhine, they have thrown their waste and refuse into the water. Many years ago, the river was able to clean itself and break down most pollutants. However, since the Industrial Revolution, the amount of waste has increased, and new kinds of waste have been added. Industrial waste, a type of waste produced by industrial activity (activity from factories, mills, and mines, for example) is not always biodegradable and can be highly toxic.

Many types of industries are built along the banks of the Rhine. Chemical industries dispose of waste that contains heavy metals, such as cadmium, lead, and mercury. Agricultural practices along the river add to the pollution by washing chemical fertilizers containing phosphates (naturally occurring compounds including salts containing phosphorus and other minerals that are vital to human and plant life and are mined for use in agriculture and industry) and pesticides into the Rhine. Households also contributed to the pollution by washing chemical-containing wastes, such as soaps, detergents, inks, processed foods, and other household items, into the Rhine.

As coal, iron, and steel became important commodities for industrialization, the Ruhr valley relied on the Rhine to transport raw materials. The Rhine's reliable navigation attracted more industries along its banks, including German chemical industries.

The consequences of these pollutants have affected every country associated with the Rhine. For example, the Netherlands depends on the port of Rotterdam for its economy. However, the Dutch must constantly dredge the harbor to allow large ships into the port. The problem starts with the metals, such as lead and cadmium, polluting the water. These metals attach to silt particles, which are transported down river and settle near river banks. The polluted silt cannot be dumped into the North Sea, so the Dutch have to dredge



Rhine River, Rotterdam, Germany, 1940

and store the polluted silt. The high concentration of phosphates in the water causes another water problem: It stimulates algae growth, which clogs pipelines and filters. In addition, the saline from German and French mining has made the Rhine waters unsuitable for watering crops further downstream. Many Dutch businesses depend on their flower crops and, therefore, must desalinate the water, which is an expensive process, before watering their gladiolas and tulips.

The fish that were once plentiful became rare by 1914. Salmon disappeared completely from the lower Rhine by 1935. The last sturgeon was caught in 1931.

### Laws and Policies Created to Keep the Rhine River Clean

Was anything done to help protect and manage the use of this important natural system? In 1815, the Congress of Vienna, one of Europe's oldest treaties, was signed to establish the Rhine as a navigable waterway. The agreement was updated

in 1831 and replaced by the Mannheim Act in 1868, which established the Strasbourg-based Central Commission of the Rhine to guarantee freedom of movement along this international waterway. In order to carry out this plan, dikes were built along the branches of the river and marshland was dredged to allow larger ships to pass.

### Examples of International Cooperation

There was some successful international cooperation. For example: In 1885, five countries along the river signed an agreement called the Salmon Treaty. The International Salmon Commission was set up to protect the fish, which were being killed by the discharge of dangerous wastes into the river and were not able to migrate because of dams and dikes. (Salmon swim out to sea when they are 18 months old and return to the place of their birth to spawn when they are four or five years old).

But international cooperation did not last for long, and these efforts did not solve all of the problems of the Rhine. During the 19<sup>th</sup> century, many engineering projects were built in and around

the river without agreements from neighboring countries. Some decisions made by cities or countries affected others along the river. For example, in 1807 the Grand Duchy of Baden (stretching from Basel, Switzerland, to Mannheim, Germany) decided to build a canal on part of the river. The German engineer who was hired increased water flow to the region by straightening the course of the river. However, the water table of the upper Rhine plain was affected when the water level fell. As a result, the softwood forests of this region no longer flooded regularly and the forests dried out.

Another example occurred after World War I, in 1919, following the Treaty of Versailles. France began constructing the Grand Canal of Alsace in 1920 without consulting neighboring countries. The canal allowed France to build 10 hydroelectric plants and dams between the cities of Basel and Strasbourg, as well as on tributary rivers, which blocked the movement of migratory fish. This waterway, which was widened in 1950, lowered the water level of the Rhine, affecting many communities along its course.



Grand Canal of Alsace, France, 2007





Rhine River, Basel, Switzerland, 2008

### Beyond the Industrial Revolution

After World War II, European countries along the Rhine decided to work together to ensure the healthy future of the river. Discussions started in 1946, and an international conference on salmon was held in 1948 to discuss the status of salmon in the Rhine. The countries agreed to set up a permanent intergovernmental body to address general issues related to pollution. The International Commission for the Protection of the Rhine (ICPR) was established in 1950, and all countries along the river agreed to fund this body. Though pollution increased over the next 20 years, the commission took regular samples from the Rhine and monitored its water quality.

In 1963, the first agreement was drafted to clean up the Rhine after the ICPR had reported on its many ecological problems. In 1976, the European Community (later the European Union) joined the ICPR and gave it more authority to carry out clean-up projects in each country. Between 1970 and 1990, the countries along the Rhine spent \$38.5 billion building purification plants to increase oxygen levels in the water so that some of the river's biodiversity could return. However, the plants

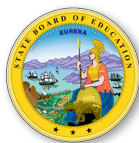
could only eliminate small amounts of the heavy metals in the water. In 1976, the countries agreed to eliminate, or separate out, dangerous chemicals flowing into the river. Another agreement was signed to reduce the salt content of the Rhine.

An ecological disaster occurred in 1986. A chemical plant caught fire and firefighters used river water containing large amounts of pesticides and insecticides to put out the blaze. Not only did the smoke from the fire pollute the air, but runoff from the firefighters' hoses killed fish and contaminated downstream river water, which had provided fresh water for many communities. This event raised public awareness to the problems on the Rhine, and policies were put in place to decrease the use of hazardous pollutants by one half in 1995. To continue clean-up efforts, this successful program was extended to the year 2000. One million young fish were successfully released into the Rhine in 1991. The ICPR continues to address the challenges that remain. However, the world marvels at the miraculous recovery of a natural system that brings several competing countries together to solve its problems.









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